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The Representation of Kabardian Harmonic Clusters

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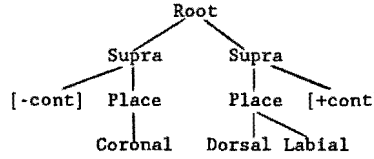
1. Introduction

Multiply-articulated segments present special challenges to theories of segment structure. A notable account for such objects is developed in Sagey (1986), where specific notions of 'complex segment' and 'contour segment' are introduced. Sagey makes strong claims about what a possible 'complex'-- multiply-articulated-- segment is, and succeeds in capturing the properties of such segments found in the languages she observes.

In this paper I will argue that Kabardian (East Circassian), a Northwest Caucasian language, has a large number of multiply-articulated segments, and that they should be represented as in A:

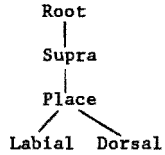
A.



For Tx*

This representation differs from the sort of representation posited universally for complex segments by Sagey:

B.

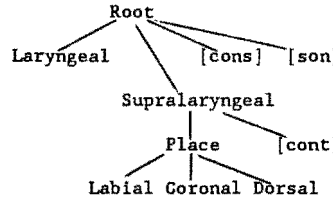


For k͡p

I argue that the Kabardian segments are different in the right ways.

I will assume the feature geometry shown in C, essentially Sagey's:[1]

C.



In sections 2 and 3 I outline Sagey's theory and some of its consequences as a point of departure. Section 4 introduces the unusual segments of Kabardian, known as 'harmonic clusters'. I give a range of arguments that they are single segments and that Kabardian in fact has no tautosyllabic clusters (I rely for some of this especially on the work of Kuipers (1960)).[2] In section 5 I show that the harmonic clusters cannot be represented as in B above, but instead have the form in A. Finally, I address the issue of phonological order within segments. I am led to conclude that it simply does not play a role at this level: Within segments there is no phonological order. This conclusion, I suggest, may not be so unwelcome as it seems, though further

[1]Throughout the paper I will indicate only as much feature content/structure as is relevant to the topic. Sagey actually locates [cont] directly under the Root node. This difference becomes important in section 5.3 below.

[2]Deprez (1988) shows that the harmonic clusters of Georgian, a South Caucasian language, are single segments as well. Though a few of the arguments are similar, the bulk of them are quite different, since the languages are very different. Harmonic clusters form only a subset of the tautosyllabic obstruent clusters of Georgian, and they can be represented as in B above. Neither statement is true of Kabardian.

research is called for.[3]

2. Complex Segments

Complex segments Sagey (1986) are single segments employing at least two independent articulatory gestures. Segments transcribed b͡g and k͡p, for instance, are common in West African languages. Sagey argues that the articulatory gestures are phonologically unordered (This property follows from her representation, as we will see below). Lack of order may exhibit itself in phonological processes. One example Sagey gives (pp.126-8) is from !Xóõ (Traill 1985), where she argues that clicks (also complex segments by her account) behave as both dorsals and coronals from the right side. A morpheme structure constraint of !Xóõ requires that only back vowels (/a,o,u/) occur following a dorsal consonant; this restriction holds of clicks as well. On the other hand, there is a rule of "dental assimilation" that raises /a/ when it occurs after a dental consonant and before (preferably) /i/ or /n/, which Sagey formulates as in (1):

(1) Dental Assimilation

a ---> ɪ̈,ə /dental_____ i,n

(2) a. /tan/ [tə̈n] 'to it'
b. /ǂali/ [ǂɪ̈li] 'fold Cl. 1'

(Traill pp. 73, 70 resp.)

Traill tells us that ɪ̈ is a "lowered-high and slightly centralized vowel," while ə is "raised-mid central."

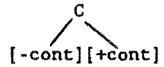
Here we find the dental click /ǂ/ (in (2b)) grouping with other dentals (l,t) as a trigger of /a/-raising.

These two facts about !Xóõ taken together, Sagey argues, show that the velar and coronal articulations in clicks are phonologically unordered.

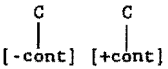
Another illustration comes from nasal assimilation in Kpelle, where /N/ becomes [m͡ŋ] before k͡p, taking on both articulations of the complex segment (and see Sagey for more arguments).

[3]Selkirk (1990) (in this volume) makes a specific claim to this effect which I will follow.

Consider now the behavior of contour segments, which often seem to exhibit phonological order (see Sagey for arguments).[4] The order is encoded in the representation directly, as in (3) for an affricate:

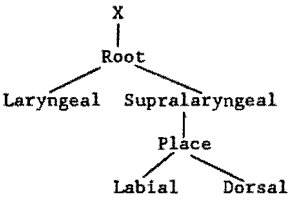
(3)


Features on one tier but linked to different segments (as in (4)) are taken to be ordered, both for the purposes of phonological rules and for phonetic interpretation:

(4)


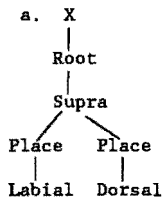
We can further make the claim, as Sagey does, that a tier defines ordering in all cases, including within segment-- as in (3).

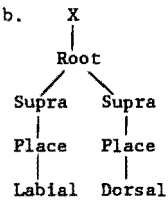
Now observe how Sagey represents the complex segment /k͡p/:

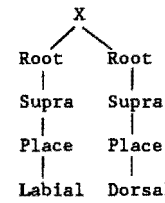
(5)


Sagey argues independently for the 'articulator' nodes Labial and Dorsal (and Coronal), following Halle (1983). The double articulation of /k͡p/ is then derived from the presence of two articulator nodes under one place node. Because Labial and Dorsal define independent tiers, no phonological order is predicted between them. Sagey points out that if the representation were instead as in (6a, b or c) we would have different expectations:

[4]Though this idea has recently been called into question, a point we will return to.

(6) a. 

b. 

c. 

Given the assumptions above, any representation in (6) would entail a phonological ordering of the articulations of the complex segment (discussion in more detail below). Sagey rules out (6a-c) in the interest of constraining the theory, stipulating that class nodes may not form contours. It follows then that complex segments are always unordered, occurring only as in (5).

But I will show below that a form along the lines of (6b) is appropriate for the harmonic clusters of Kabardian.

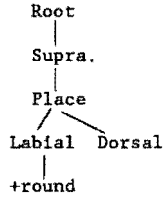
3. More Consequences of the Analysis

Consider again two assumptions of the discussion so far: First, elements on a single tier are taken to be phonologically ordered, both within and across segments. Second, class nodes may not form contours. Suppose that the second assumption could not be maintained-- suppose we found an apparent case of (6a,b or c). Then, given the first assumption, we would expect the articulations of such a segment to be ordered phonologically, under the natural assumption that order between two elements carries over to their respective dependents. Taking (6b) in particular: Though Labial and Dorsal define independent tiers, in this case they are dependent on different Supralaryngeal nodes, and the latter are necessarily ordered. Therefore in a structure like (6b) the articulator nodes are ordered.

In fact, I will argue that both assumptions above must be dropped; not only can class nodes form contours, but the result we find does not entail phonological order-- that is, it is not properly a 'contour' at all. Let us first explore more consequences of an analysis maintaining the original assumptions.

The idea of 3 independent articulators-- the lips (the lower lip in Halle (1983), following Anderson (1971)), the tongue blade and the tongue body-- seems well founded (for discussion see Halle and Sagey). For example, the labialized velar /x^{w}/ of Proto-Circassian, which can be represented as in (7),

(7)



has changed to /f/ in West Circassian (Adyghe) (Catford 1977). This change can be fairly naturally represented by delinking the dorsal node in (7) (though we must account for the change to [-round]). In a framework that holds labialization to be merely a feature [+round] on a consonant and not an 'equal' and independent articulation, such a sound change is less natural (see Campbell (1974)) for similar examples from many languages).

Halle (1983) predicts that only the following kinds of complex segment could occur:

(8)	labio-velar	[k͡p]	Yoruba	[ak͡pa]	'arm'
	labio-coronal	[p͡t]	Margi	[p͡tʊl]	'chief'
	corono-velar	[ʔ͡ǂ]	Zulu	[ʔaǂa]	'climb'
		(click)			

labio-corono-velar ?

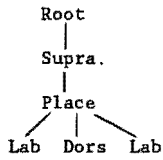
(Examples from Halle).

Halle had not found a case of a labio-corono-velar, but Sagey cites [tkw] from Kinyarwanda (p. 58).

These are all and only the possibilities, according to Halle, "since there are three active articulators and since a given articulator can be only at one point at a given time" (pp. 98-9).

Sagey's theory nicely encodes this prediction, under the assumptions above. If class nodes, including articulator nodes, may not form contours, then only the four complex segment types listed above are possible. (6) is not possible; nor is (9):

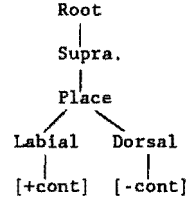
(9)



There is another rather strong prediction made by a

representation for complex segments as in (5). The prediction is that the articulations of a complex segment may not bear different underlying [continuant] values (They may be different at the surface-- see below). Sagey presents evidence that [cont] cannot occur within the Place node (place assimilation can occur without [cont] assimilation). For there to be a complex segment where one articulation is specified [-cont] and another [+cont] (/k^{w}/), we would need a representation along the lines of (10):

(10)



As Sagey points out, if we were forced to (10) we would be left with a radically different feature geometry for complex segments, an unwanted prospect. Assuming that [cont] always attaches to the Root or Supralaryngeal node, we predict that a segment may bear only one [cont] value underlyingly.[5]

Yet we do find complex segments like k^{w} on the surface. Sagey does not claim that all articulations within a segment must share one constriction feature. The answer is to say that, in the case of articulations that do not share the underlying constriction value, their own values must be predictable-- at least within the language in question. For example, Margi has the labio-coronals /p͡t/ and /p͡s/ but not /*f͡t/ or /*f͡s/-- at least not in contrast. Sagey suggests that a language-specific stipulation determines that the labial articulation for these segments must be [-cont] (p. 184). In her terminology, "major" articulators are those that the feature [cont] refers to in phonological representation; "minor" articulators are those for which this feature must be predictable.[6]

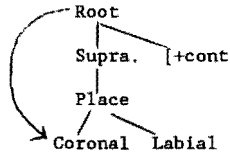
But how to represent this connection between only certain articulators, located within the place node, and the feature [cont]? Sagey stipulates a relationship between the root node and

[5]Affricates may be represented as [-cont][+cont], as noted above, but this is an independent issue.

[6]Maddieson (1983) and (1987) has argued convincingly that the labio-coronals of Bura and therefore of closely related Margi are not single segments but rather a sequence of segments. I retain the discussion here, though, for expository reasons. The point can be made with /k^{w}/ or another example.

any articulator, represented by a pointer, which determines the major articulator, i.e. the articulator that is referred to by [cont].[7] Margi /p͡s/ has the form in (11):

(11)



The pointer tells us that it is the coronal articulation that is underlyingly [+cont]; the labial becomes [-cont] by a language-specific rule.

To sum up, if complex segments-- multiply-articulated single segments-- occur only as in (11) (and there are no class node contours), we predict that I) no two instances of the same articulator may occur, and II) no two articulations within a complex segment could bear different distinctive [cont] specifications.

4. Kabardian Harmonic Clusters

4.1 Kabardian (East Circassian) has segments, 'harmonic clusters', that seem to defy both predictions given just above. Before delving into the arguments, though, I first present the 'clusters' themselves and then argue that they are single segments. Most of my information is taken from Kuipers (1960), but see also Anderson's (1978) discussion-- the first attempt to represent these 'complex' segments in nonlinear terms. Below is a list of those attested in Kuipers.

A word on the notation used. Harmonic clusters generally share one laryngeal articulation (hence the name "harmonic cluster"); they are either entirely voiced, voiceless or glottalized-- in the last case one glottal constriction ranges over all the articulations. The phonetic details are not quite this simple (see Kuipers), yet there is only one distinctive laryngeal feature per harmonic cluster. Kuipers encodes this fact in his notation: /Pz/=[bz], /Ft/=[ft], /Lq'/=[l'q'] (=one glottal constriction) and so on, where P is a labial articulation undefined for laryngeal features, etc. I will adopt this notation for the harmonic clusters, since in what follows it will be convenient to refer to harmonic clusters (Pz, etc.) as opposed to

[7]See Sagey p. 206, note 21 for arguments that the relation cannot hold between the articulator and the feature [cont] directly.

true clusters (bz, etc.).

The harmonic clusters are grouped by the first articulator in the sequence (labial-initial, etc.); these groups are further subdivided into stop-fricative, stop-stop, etc., groups, and these groups are divided according to whether they are voiced, voiceless or glottalized. Coronal-initial segments are of several types, since there are several coronal types: besides S- and T- initial we find Ṣ- (alveolo-palatal) and Š- (palato-alveolar) and Ł- initial (Note: laterals in Kabardian are fricative obstruents). For details on the sounds of the language and the symbols used see the list of simple segments of Kabardian at the end of the paper.

Harmonic Clusters

labial initial stop-fric.						
Ps	Pṣ	Pš	Pχ	Pxʸ	Pχ̄	Pχ̄ʷ
Pz	Pẓ	Pž	Pl	Pɣʸ	Pɣ̄	Pɣ̄ʷ
	Pṣ'		Pl'			
stop-stop/affricate						
Pʒ	(Pgʸ)					
Pc'	Pkʼʸ	Pq'				
fric.-stop						
Ft						
coronal initial stop-fric.						
Txʸ	Txʷ	Tχ̄	Tχ̄ʷ	Tƀ		
stop-stop						
Tkʼʸ	Tkʼʷ					
fric.-stop						
St	Skʷ					
Sd	Sgʸ					
Skʼʸ	Skʼʷ					

Śt
Šg^{y}
Šk'^{y} Šk'^{w}
(Lp) (Lk^{w})
Lq'
fric.-fric.
S$\bar{x}$ Sḫ
Ś$\bar{x}$ Ś$\bar{x}^{w}$ Śḫ
Ś$\bar{\gamma}$
Šx^{y} Šx^{w}
Lx^{w} L$\bar{x}$ Lḫ
dorsal intial fric.-stop/affricate
$\bar{X}$c
fric.-fric.
($\bar{X}$s) $\bar{X}$š

(In parentheses are harmonic clusters appearing only in borrowings).

There are also seven larger harmonic clusters:

PSt PSk^{y} PSk'^{y} PŚt PŠk'^{w} PŠḫ ST$\bar{x}$

Note that the name 'harmonic cluster' is misleading, since I argue here that they are single segments. Under the analysis presented here, Kabardian has no tautosyllabic obstruent clusters at all.[8]

4.2 Harmonic Clusters as Single Segments

Although Kuipers and Anderson treat harmonic clusters as unisegmental, it is not strikingly apparent upon first glance that they are. They are unlike the more familiar complex segments of

[8]Except at word-edges-- see below.

West Africa in being so numerous and varied: 63 harmonic clusters plus the 48 simple consonants of Kabardian makes a total of 111 underlying consonantal segments.[9] Also, some of the harmonic clusters are very restricted in occurrence, a few appearing in one root only. It is difficult to contrast them with true tautosyllabic clusters, since by hypothesis all tautosyllabic obstruent 'clusters' are harmonic clusters, i.e. single segments--except at word-edges (see below).

I turn now to arguments that harmonic clusters are single segments.

4.2.1 Minimal Pairs: Harmonic vs. True Clusters

Kuipers gives us the minimal pairs shown in (12) and (13):

(12) a. q'a.Pśahr 'the one who crept hither'

(q'a- 'hither' + Pś 'creep' + -ah past + -r abs)

b. q'ap.śahr 'the sold sack'

(q'ap 'sack' + ś 'sell' + -ah past + -r abs)

(13) a. q'aPś 'creep hither!'

b. q'apś 'it is a sack' (-s̄ = predicative)

In (12a) the harmonic cluster Pś forms the onset of the second syllable, while the p and ś are heterosyllabic in (12b). (The syllable boundary is marked by a period). In cases like this it is always true that a morpheme boundary coincides with the syllable boundary. We might then try to avoid the conclusion that Pś in (12a) is a single segment by supposing that syllabification is cyclic and that no resyllabification occurs. Yet (13a & b) show that this approach cannot be right. Both of these examples comprise a single syllable, and yet they too are phonetically distinct, though here the distinction is more easily dropped. According to Kuipers, the difference between (13a & b) lies in the degree of energy with which the initial member of the cluster is pronounced. Non-final articulations in a harmonic cluster are "weak both from the point of view of expiration (and hence unaspirated) and from that of muscular tension." (p. 19)

The minimal pair in (13a & b) is possible because there

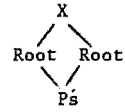
[9]Kabardian might be compared to !Xóõ in this respect, which has a total of 116 consonantal segments if its clicks are counted as single segments. Chomsky and Halle (1968) and, more recently, Sagey (1986) treat clicks in this way, though see Traill for a different view.

exists a limited class of word-final morphemes, like the predicative -ś, that syllabify with a preceding consonant or harmonic cluster. As noted, I will argue that there are no tautosyllabic obstruent clusters otherwise.

There is nothing mysterious about these minimal pairs if harmonic clusters are in fact single segments. In that case, the distinction is as in (14a-b). I adopt henceforth the view of Hyman (1984), McCarthy and Prince (forthcoming) and Hayes (1988) in which skeletal slots are eliminated from the theory in favor of the mora. This stance forces us to take the Root node as encoding single segment status. This result is actually welcome here, because it predicts correctly that harmonic clusters always share the major class features (they are all obstruent clusters) and a single laryngeal specification-- all Root-dependent features (see the geometry assumed in the introduction). (15) would not make either prediction.

(14) a. Harmonic Cluster b. True Cluster (word-final only)

(15) Harmonic Cluster:



4.2.2 Regressive Articulation

The second piece of evidence that harmonic clusters are single segments comes from an interesting fact about them: They are articulated from front to back in the oral cavity (ignoring secondary articulations-- labialization and palatalization). So we have examples like Pc', T$\bar{x}$ and Lq', but no *Cp', *$\bar{X}$t or *Ql'.

Actually, 10 of the 63 harmonic clusters listed are exceptions to the generalization. These exceptions fall into two classes. There is a systematic class, made up of the fricative-stop coronal clusters St, Sd, St (and in PSt, STx and PSt). The other exceptions are Lp, $\bar{X}$c, $\bar{X}$s and $\bar{X}$ś. $\bar{X}$s and Lp appear only in borrowings, while $\bar{X}$c and $\bar{X}$ś occur in only one or two words each as non-initial members of a compound (Kuipers p. 85).[10]

[10]Though note that a few regressive harmonic clusters are also very restricted in occurrence.

The important generalization, though, is that order of articulations is not contrastive in harmonic clusters. If we strictly apply the principle that only contrastive information is specified underlyingly, then we must conclude that harmonic clusters are underlyingly unordered.

We might then ask, By what means are the articulations ordered during the derivation? As Kisseberth and Kenstowicz (1979) observe, regressive (front to back) articulation is not at all easy to achieve by a constraint stated in terms of binary features. But there is a larger issue here: While sonority restrictions, OCP restrictions (*dl) and idiosyncratic restrictions (*$\widehat{sp}$ in English) on segment sequences are common among languages, nowhere else do we find an apparent phonological restriction ordering articulations (or consonants) by place in some way (i.e., front to back, back to front, etc.), regardless of how we would state this restriction.

Let us suppose instead that regressive articulation is a result of language-particular phonetic implementation. Perhaps this would be the case if the articulations are timed to overlap to a certain degree. In that case, the requirement that each articulation be perceptually salient might entail that they be released from front to back in the oral cavity. A velar release, for example, would not be audible if closure were still maintained further forward in the oral tract. On the other hand, a labial release could be audible even if it occurred during velar closure, though some at least slight secondary airstream mechanism would be required. Under this interpretation of regressive articulation, it is not surprising that initial articulations in harmonic clusters are 'weak' in both aspiration and muscular tension, as reported by Kuipers.[11]

Summing up: The order of articulations is not contrastive among harmonic clusters. I therefore assume that it should not be represented underlyingly for Kabardian, and further, that it is a matter of implementation. If harmonic clusters are a sort of complex segment type, then this lack of underlying order is expected, as Sagey (1986) has shown.

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[11]It must be considered that perceptual salience may also be achieved solely by the effect of an articulation on the formants of neighboring vowels. In this case regressive articulation is unnecessary, and in fact it is not a feature of some West african complex segments. It seems unlikely to me, though, that formant transitions could act as a sole cue to the presence of coronal or velar articulations in Kabardian, where the sheer number of types of articulation, as well as the frequent presence of labialization, would make the task of perceiving these effects difficult. I assume therefore that each articulation must have a perceivable release.

4.2.3 Sonority

A third kind of evidence that harmonic clusters are single segments comes from their behavior with respect to the usual sonority hierarchy assumptions. The following underlined sound sequences from Kabardian, located within the syllable as shown, are marked across languages:[12]

(16) a. Ftə 'sex organs (male and female)'
b. jaTx^{y} 'he writes it'
c. PχamPʒ^{w} 'board'
d. jaPɣ 'looking at him'

Since harmonic clusters occur freely anywhere in the syllable (see section 4.2.5), such apparent sonority anomalies are common in Kabardian. The point, again, is that they are not so unusual if we assume that the harmonic clusters are unisegmental. Sonority sequencing principles plausibly do not extend to within a segment (affricates normally appear freely syllable-initially and -finally). We do not, then, need to say anything special about harmonic clusters-- their articulations are irrelevant to sonority sequencing.

4.2.4 Harmonic Clusters and the Status of ə (Schwa)

Kuipers (1960) argues at some length that Kabardian has no underlying vowels; the proposal that the vowel ə (schwa), at least, is not phonemic is taken seriously by a number of linguists (see Anderson (1978), who argues in favor of this analysis, and Kumakhov (1973) and Halle (1970), who try to refute it). It seems clear that no more than two vowels are required underlyingly: a and ə , making the language interesting in any case.[13]

Kuipers does not believe that ə is phonologically epenthesized; rather, it is the realization of the 'syllabicity' of a syllabic consonant.[14] This proposal, which leaves the language with only the one vowel phoneme a, implies that there are

[12]Where fricatives are more sonorous than stops.

[13]a is central low; ə is most typically central mid-high. Both vowels, though, are highly colored by the surrounding consonants.

[14]Hoard (1978) is a more recent example of a similar analysis of some Pacific Northwest Indian languages. In Bella Coola, according to Hoard, obstruents can be syllabic and even bear stress.

many underlying forms as in (17a), realized as (17b):[15]

(17)	a.	/Ps/	b.	[Psə]	'water'
		/vnd/		[vənd]	'rook'
		/Pʒaq'ʷnTxʸ/		[Pʒaq'ʷənTxʸ]	'fishing hook'

The issue is important for this paper because, if this analysis is correct, then we have another compelling reason to treat harmonic clusters as single segments. We need to distinguish pəχ 'hanging, intr.' from Pχə 'getting hot', and so on:

(18)	a.	/pχ/	[pəχ]	'hanging, intr.'
	b.	/Pχ/	[Pχə]	'getting hot'

Under this analysis, ə is inserted following every consonant, except word-finally.[16] At the level where insertion occurs, /Pχ/ is treated on a par with /p/-- as a single consonant.

The status of ə has been controversial, though Anderson accepts Kuipers' analysis and shows that Halle's objections to it become less serious in the context of more recent phonological theory. Let us review the evidence that ə is not phonemic.

First, more than a, ə varies in prominence or length to a high degree. Kuipers calls it "ultrashort" and says that it

> can shrink to a hardly perceptible murmured release of the preceding consonant and even disappear altogether. This happens particularly in longer words, especially-- but not exclusively-- in more rapid speech. Frequently a sequence of a short high vowel and a consonant is replaced by a syllabic consonant, not only in the case of m, n and r but also with other consonants, cf. l'əź 'old man', phonetically l'iź or l'ź̩. [ź̩ is a syllabic ź, JP] (p. 24)

The tendency for ə to shorten and disappear, and the apparently gradient nature of the effect, suggest that it is not underlying, but rather a late-level 'excrescence' (see Levin (1987)). In fact, ə lacks any place quality of its own, according to Colarusso (1979), who tells us that "$C_1əC_2$ means 'go from 1 to 2 by the shortest sonorant path possible.'" ə is plausibly a transition vowel of some sort, then.

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[15]Phonetic transcriptions are broad-- there is much vowel coloring that I am not indicating.

[16]ə appears finally in (18b) since there is no other vowel to carry the syllable. The facts of ə insertion are more complicated than this. See below.

If this is so, then the appearance of ə must be predictable. Following Kuipers, let us divide the Kabardian word into three parts: Pre-stress syllables, the stressed syllable, and post-stress syllables. Each word receives one stress, on the final syllable if it is closed, on the penultimate syllable otherwise:

(19) a. l'ə́ 'man'

b. l'ə́ź 'old man'

c. l'ə́k'ʷa 'messenger'

d. l'ə́k'ʷaźə́f' 'good old messenger'

e. l'ə́źə́f'ə́Šxʷa 'great good old man'

ə does not appear word-finally (but see note 16), as the following show:

(20) a. l'ə́źə́f'ə́Šxʷa 'great good old man'

b. l'ə́źə́f' 'good old man'

c. l'ə́f' 'good man'

d. l'ə́ź 'old man'

cf. l'ə 'man', źə 'old', f'ə 'good'

These facts would suggest that ə can never appear after the stressed syllable. This is not exactly true, however. There is a small set of suffixes that neither bear stress nor affect its placement, called 'stressless' by Kuipers. We may assume that they are attached at a level following stress assignment.[17] ə does appear in the post-stress part of a word when these suffixes are added. Its appearance seems to be determined only by sonority requirements (see Kuipers p. 41 for a precise formulation). In (21) /-r/ and /-m/ are absolutive and oblique case endings, respectively, and /-ś/ is a predicative ending; they are all 'stressless':

[17]These are some of the word-edge affixes that may form true tautosyllabic clusters, otherwise excluded, as seen in section 4.2.1.

(21) a. bəj + -r ---> bəjr [bir]
'enemy, abs.'

bəj + -ś ---> bəjś [biś]
'it is an enemy'

fəz + -ś ---> fəzś [fəzś]
'it is a woman'

b. fəz + -r ---> fəzər [fəzər] or
'woman, abs.' [fəzr̥]

fəz + -m ---> fəzəm [fəzəm] or
'woman, obl.' [fəzm̥]

In (21b) neither -r nor -m can follow z in coda position, since they are higher in sonority, and so ə must appear (or, alternatively, the final consonant is syllabic). In (22) is another example:

(22) a. l'əź + -r ---> l'əźər [l'əźər] or
'old man, abs.' [l'əźr̥]

Since in this part of the word the appearance of ə is predictable on the basis of sonority requirements, we do not want to claim it is underlying. Rather, the facts support the view that it is a sort of transition vowel, inserted at a fairly late stage.

Yet ə behaves differently in the stem of a word-- pre-stress and under stress. Under Kuipers' analysis Kabardian allows only CV syllables; every consonant (simple or harmonic cluster) is followed by either a or ə at the surface (ə by late insertion). Notice, then, that we can therefore predict, trivially, the appearance of ə: if a consonant is not followed by a, then it is followed by ə[18]. This is in effect Kuipers' argument.[19] Of course, this is predictability in a logical sense, but it does not seem a phonological necessity. Yet given the

[18]Although the claim about syllable structure is obvious given his analysis, he makes it more explicit in Kuipers (1968). Codas can appear word-finally due to failure to insert ə in that position (see example (20)). We also find CVR and CVRC syllables at the surface, where R is a sonorant consonant, as in PẌan 'goat' and PẌamPỸʷ 'board'. Thus, more precisely: ə is inserted following every obstruent, when a does not follow (and not word-finally).

[19]It is a bit more involved, since Kuipers eliminates a as a vowel phoneme as well-- reanalyzing it as a feature of the preceding consonant. This does not affect our point here.

obvious phonological redundancy of ə in the post-stress domain, it seems reasonable to pursue the point.

There is now some circularity in the argument, however. The point I wish to argue ultimately, recall, is that harmonic clusters are single segments. To this end, I am now arguing that the vowel ə is not underlying: If ə is not underlying, then we must distinguish pairs as in (18) in some other way, and it is natural given other arguments to do this by treating harmonic clusters as single segments. Yet the predictability of ə in pre-stress and stressed positions (though not post-stress) hinges on the assumption that Kabardian is CV, that is, on the assumption that harmonic clusters are single segments. We therefore require independent evidence that Kabardian disallows complex onsets (more than a single consonant in onset position).

Evidence comes from an interesting ə-zero alternation so far left unmentioned. There is a pervasive exception to the claim that every obstruent consonant or harmonic cluster is followed by either a or ə. The rule is formulated by Kuipers (p. 44): "ə is absent at the border between two immediate constituents both of which contain more than one single consonant or cluster". An example is given in (23). Let us assume for the moment that ə in fact is not underlying, so that [l'ə] 'man' is underlyingly /l'/, and so on. The ə underlined in the surface representation in (23a) is missing in (23b):

(23) a. /ha + (l' + (ź + dda)) + r/
[hal'əźəd̈əd̈ar] = 'that very-old man abs.'

b. /ha + ((l' + ź) + dda)) + r/
[hal'əźd̈əd̈ar] = 'that very (same) old man abs.'

From ha- 'that', l' 'man', ź 'old', -dda 'very', -r (abs)

The abbreviated morpheme structure given in (23a and b) reflects the difference in meaning between them.

We can infer from Kuipers that all instances of word-medial obstruent codas in Kabardian are due to this failure to insert ə; as noted before, Kabardian has no underlying codas.

To make sense of this process, I first identify it with the general word-final ə-zero alternation observed in the surface forms in (20) above, repeated here:

(20) a. l'ə́zə́f'ə́šxʷa 'great good old man'
b. l'ə́zə́f' 'good old man'
c. l'ə́f' 'good man'
d. l'ə́z 'old man'

cf. l'ə́ 'man', źə́ 'old', f'ə́ 'good'

We have already seen that ə́-insertion does not occur word-finally, unless the word consists of a single consonant (simple or harmonic cluster). When ə́ fails to appear internally, as in (23b), we can assume it is for the same reason-- the immediate constituent (l'ə́ź) in (23b) is a word in the relevant sense (equivalent to (20d), and the full form is therefore a compound.

Now back to Kuipers' formulation. What it in effect says is that ə́ will never appear in instances represented as (24a) but will always appear in (24b) or (24c) (henceforth C is an obstruent, simple or harmonic cluster):

(24) a. (...CVC) + (CVC...) ---> ...CVCCVC...
b. C + (CV...) ---> CəCV...
c. (...C) + CV ---> ...CəCV

If ə́ is a 'transition' vowel in this pre-stress and stress domain (as it clearly is in the post-stress domain, recall), we can assume it provides a transition from C to C. ə́ need not appear in (24a) at the word boundary, since it never occurs word-finally. It must appear in forms like l'ə́ 'man', though word-final, in order to realize the syllable and bear stress. Similar reasons require the appearance of ə́ in (24c), though it is not word-final.[20] But why must ə́ appear in (24b)? The answer, it

[20]If ə́ is not underlying, then we must allow stress to be assigned to, essentially, syllabic consonants, and then realized later on ə́:

a. (l' + ź) + f' ---> l'ə́źə́f'

b. (l' + ź) + šxʷa ---> l'ə́źə́šxʷa

As Kuipers notes, the stress rule is then simplified. Instead of "Stress the final syllable if it is closed, otherwise the penultimate," we have uniform penultimate stress. Since ə́ does not appear word-finally, f' is incorporated as a coda in (a).

(a) and (b) are both instances of (24c). The appearance of ə́ in these cases, giving (l'ə́źə́-) instead of (l'ə́ź-), is evidently due to stress. As with the surface form l'ə́, ə́ must appear to

seems, is that failure to insert ə would result in a derived tautosyllabic CCV sequence, with a complex onset. We never find (25a), then, but rather (25b), though P$\tilde{\gamma}$ is an occurring harmonic cluster.

(25) a. b$\tilde{\gamma}$V...
b. bə$\tilde{\gamma}$V...

The fact that ə must appear here is strong evidence that onset clusters are not allowed in Kabardian. If this is so, then the harmonic clusters must be single segments. With only a few exceptions, all of the complex segments listed may occur as onsets.

I should say that this argument is independent of the status of ə. Even if we rejected arguments that ə is redundant and posited word-final ə-deletion rather than a failure to insert it, the above facts would argue that ə deletion cannot apply just in case it would create a tautosyllabic cluster. Now, however, we have our independent evidence that Kabardian has only CV syllables, and this allows us to further argue that ə itself is completely predictable-- post-stress by sonority, and otherwise by the fact that every C must be followed by a vowel, and if no a follows, then it must be ə. If ə is predictable, furthermore, then surely harmonic clusters must be single segments, to distinguish pairs as in (18), repeated here:

(18)	/pχ/	[pəχ]	'hanging, intr.'
	/Pχ/	[Pχə]	'getting hot'

These arguments taken together constitute a compelling evidence that harmonic clusters are single segments. First, there are strong reasons to assume that ə is not underlying, while we must distinguish the pair in (18); second, independent evidence shows that Kabardian does not allow onset clusters, while harmonic clusters are common onsets.

I have not yet addressed the possibility that some of the harmonic clusters are complex segments, and others are not. If either of the arguments just detailed is right, then such a possibility is excluded.

4.2.5 More on the Distribution of Harmonic Clusters

The distribution of harmonic clusters within the syllable also lends support to the claim that they are single segments. The point is easy to state: they occur everywhere that single segments do (p, q, etc.)-- that is, not only as onsets, but also

---

bear the stress.

as (word-final) codas due to failure to insert ə:

(26)	Psə	'water'	wəPs	'plane!'
	PƵan	'goat'	ɣʷəPƵ	'Tuesday'
	Tk'ʷə	'melt!' (intr.)	ɣaTk'ʷ	'melt!' (tr.)
	Šk'ʷəmp'	'bad egg'	ɣanəŠk'ʷ	'chew!'
	Lxʷə	'give birth!'	daLxʷ	'brother' (of a female)

(Examples from Kuipers p. 29).

In coda position they may be preceded by a sonorant (about sonorants in this position see footnote 18):

(27)	PʒaqʼʷənTxʸ	'fishing-hook'
	PXamPɣʷ	'board'

Finally, they combine freely with the word-edge 'stressless' affixes mentioned above.

This concludes the arguments that harmonic clusters are single segments. In the remainder of this paper I will take up the issue of their representation in feature geometry and some implications for the theory.

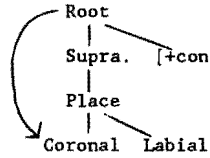
5. The Representation of Harmonic Clusters

In this section I show that harmonic clusters have properties that set them apart crucially from those of complex segments examined by Sagey (1986). A form with two Supralaryngeal nodes is posited.

5.1 Articulator Groupings in Harmonic Clusters

Recall that a representation as in (11), repeated here, and a prohibition on branching to class nodes, makes the prediction that only four types of complex segment can exist: labio-coronal, labio-velar, corono-velar and labio-corono-velar.

(11)



For p͡s

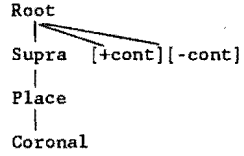
Though Kabardian conforms to a notable extent, there are obvious exceptions. First, six segments involve two coronal articulations:

(28) St, Sd, Ṡt, PSt, PṠt STx̄

It may not be appropriate to speak of 'two articulations' in these cases, though at least for those involving the articulation S combined with a dental stop we can speak of two coronal places.

Adhering to a form as in (11), we cannot account for these distinctions. A sequence of coronal articulator nodes is disallowed, recall, by the stipulation that class nodes may not form contours. On the other hand, we cannot attempt to call the segments in (28) 'backwards' affricates, that is, represent them as in (29):

(29)



(29) is wrong because the segment Ṡt, as noted, involve two places of articulation as well as two instances of [cont]; that is, the fricative and stop portions differ in coronal-dependent place features. We cannot represent this with just one coronal node.

Other segments of Kabardian bear two labial articulations each:[21]

(30) a. Pχ̄ʷ, Pγ̄ʷ
b. Pχ̄, Pʔ
c. χ̄ʷ, γ̄ʷ

We do not have in (30a) merely some phonetic realization of one labial articulation; below are minimal pairs exhibiting the contrasts among (30a,b and c):

[21]I follow Sagey in regarding labialization as an instance of Labial under Place.

(31)

a.		b.		c.	
Pχ̃ʷə	'daughter'	Pχ̃ə	'carrot'	χ̃ʷə	'male'
Pχ̃ʷa	'grasping'	Pχ̃a	'wood'	χ̃ʷa	'filling'
Pɣ̃ʷə	'nine'	-		ɣ̃ʷə	'drying out'
Pɣ̃ʷa	'carcass'	Pɣ̃a	'breast'	ɣ̃ʷa	'burrow'

We can attempt to represent the consonant segments in (30b and c) as in (32):

(32)

a. Pχ̃: Root — Supra — Place — Labial, Dorsal — [-rnd]

b. χ̃ʷ: Root — Supra — Place — Labial, Dorsal — [+rnd]

But then how are we to represent /Pχ̃ʷ/? Again, a sequence of labial nodes is disallowed.

Concluding this section, then: Kabardian harmonic clusters differ from complex segments of languages investigated by Sagey in that they can evince more than one instance of certain articulator types.

5.2 The Continuant Feature in Harmonic Clusters

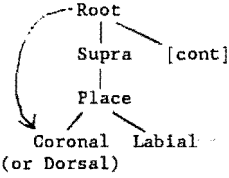
Referring again to representation (11), if [continuant] is a property of the entire segment-- independent of the place features in particular-- then we do not readily expect to find that individual articulations may bear different underlying [cont] values. Where different values appear on the surface, we expect to find that one is derived by either a universal or a language-specific default rule. In Sagey (1986), sometimes the latter amounts to a language-particular restriction on complex segments alone. So for example Margi requires that the labial articulation of its labio-dentals be [-cont]; we cannot say the same of its simple segments: Margi has the phonemes /f/, /v/ and /w/ (But see footnote 6).

Turning to Kabardian harmonic clusters, we do find that labial articulations are overwhelmingly stops, as in (33), ignoring the exception shown:

(33) Ps, Pq', $P_{\overline{3}}$, etc. (But note: Ft)

So far then we might retain the analysis embodied in (11) for these segments, letting a redundancy rule supply [-cont] to the labial. These segments would be represented as in (34):

(34)



The pointer indicates that the [cont] specification refers to the coronal (or dorsal) articulation.

The problem lies among the coronal-dorsal harmonic clusters, where it appears the distribution of [cont] is not so straightforward. [cont] distinguishes among coronal articulations, as shown by the minimal pairs in (35):

(35) a. Tk'^{y} vs. Sk'^{y}
b. Tk'^{w} vs. Sk'^{w}
c. T$\bar{x}$ vs. S$\bar{x}$
d. T$\underset{\smile}{h}$ vs. S$\underset{\smile}{h}$

We could attempt to state default rules for [cont] among the dorsal articulations, then. Yet no compelling generalizations arise. So, regarding the examples in (35) we might suppose that the coronal articulations are underlyingly specified for [cont], while the following rules determined [cont] for the dorsal articulations:

(36) a. [+constr. glottis] ---> [-cont]
b. otherwise: default = [+cont]

These rules do not hold of segments in general in Kabardian, which has the glottalized fricatives f', ś' and l'. In fact, they do not hold of all harmonic clusters either. We also have Sk^{w}, Sg^{y} and Šg^{y}. So we are forced into 'default' rules for particular segments or sets of segments. What can we say, for instance, about the pair in (37)?

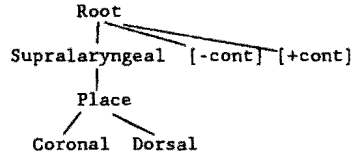
(37) Sk^{w} vs. Tx^{w}

We must, I believe, somehow specify underlying [cont] values for both the coronal and dorsal articulations.

This observation, though, puts us into a quandary: With [cont] attached higher than the Place features, how do we

represent the harmonic cluster Tx^{w}, for example, with [-cont] specified for the coronal articulation, and [+cont] for the dorsal (ignoring the labialization for the moment)? The minor change of representation shown in (38) cannot be the answer. Even if it were possible to use the pointer notation to indicate which [cont] value associates to which articulator, we seem to be making the paradoxical claim that the [cont] features are phonologically ordered, though the articulations they associate with are not.

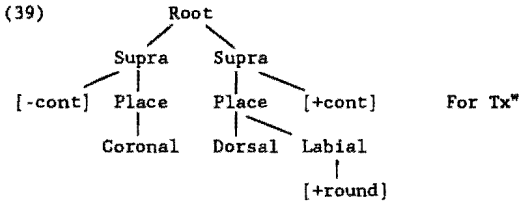
(38)



5.3 Allowing Branching to Class Nodes

Suppose we do away with the prohibition on branching to class nodes proposed by Sagey. Even with [cont] attached to a node higher than the articulator nodes, we might still achieve the specification of [cont] for individual articulators:[22]

(39)



Recall from section 4.2.1 that harmonic clusters should be represented with a single Root node: We can maintain the absence of timing slots in this way, and we predict that articulations of harmonic clusters always share major class and laryngeal features. Therefore the branching must occur below Root. It must also occur above Place, if we hope to thereby derive two or more [cont] specifications. [cont] cannot be dependent on Place, since place assimilation does not entail [cont] assimilation (see Sagey (1986), Clements (1985), for arguments). This leaves us with the representation in (39).

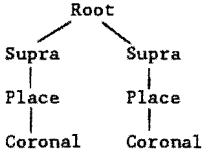
In (39) we see very ordinary subsegmental structure combined with the familiar notion of branching. Notice that I must group [cont] with Supralaryngeal rather than follow Sagey and group it

[22]Since [+cont] is predictable for [+round], we may group the labial articulation with the dorsal in our representation.

with the Root node, but as Sagey points out (p. 45, fn. 16) there is no evidence that favors either analysis over the other.

This solution now solves our other problem-- the existence of harmonic clusters with more than one instance of a labial or coronal articulation. They can evince more than one instance of one articulator type because of the branching to two Supralaryngeal nodes:

(40)



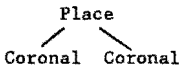
For Śt

For the same reason the different articulations can be independently distinctive for the feature [cont]. Only a solution in the spirit of (39) can make a natural connection between these two otherwise unrelated problems presented by Kabardian.[23]

A form with two Supralaryngeals brings up some obvious questions, especially: 1) if harmonic clusters are represented in this way why are they in fact so restricted in type? 2) Are the articulations therefore phonologically ordered?

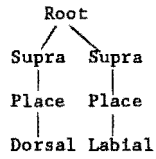
By the first question I mean, for instance, why are there no harmonic clusters as in (41)?:

[23]Since we now allow branching to class nodes, the representation shown below could just as well account for Śt, if it weren't for the issue of [cont]:

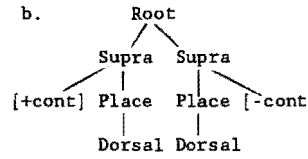


Though the use of branching class nodes is fairly common in the literature now, we might like to constrain their appearance; but I have little to say in what follows. Note though that a simple notion of complexity that counts nodes or branches will explain why harmonic clusters are less common than complex segments represented according to Sagey.

(41) a.



b.



For (hypothetical) Kp For (hypothetical) X̄k

Taking up (41b) first, why do we in fact find so few harmonic clusters with two instances of one articulator type? Those extant are limited in type: coronal groups like St, or clusters with secondary articulations, PX̄^{w} (two labials), Tx^{y} (two dorsals). Surely the reason was already noted by Halle (1983): an articulator can be at only one place at a time. Suppose we accept that part of what it means to be a single segment is that the articulations occur at roughly the same time (see Maddieson and Ladefoged (1988)). Then only one instance of any articulator type will occur per segment, as predicted by Halle. Consonants with secondary articulations are a familiar exception to this generalization (palatalized dorsals and labialized labials). Kabardian then is not unusual for having such exceptions. As for the other class of exceptions in Kabardian-- St, Sd, Sṭ-- it is at least suggestive that just such sequences are found to have some properties of single segments in other languages (see Ewen (1982) and references therein), unlike sequences like (41b). But in largely lacking more than one instance of one articulator type, then, harmonic clusters seem very natural.

Of course, the prohibition on branching to class nodes and the feature structure proposed by Sagey (1986) were in part advocated because together they predict this restriction on single segments. Yet it seems unnecessary and undesirable to build it into the phonology, since we have already found a plausible physiological explanation for it.

There is no reason, then, to conclude that the representation advocated in (39) and (40) predicts a much greater variety of articulator groupings within a segment than was predicted in Halle (1983), though as we have seen, it does give us the means to account for the coronal groups St, Sd and Sṭ, as well as the three-way distinction PX̄, X̄^{w}, PX̄^{w}.

Turning to (41a) now: This segment does not occur for already familiar reasons: Harmonic clusters are generally regressive, articulations proceeding from front to back in the oral cavity. Here, though, a new problem arises, mentioned above. We have seen how a representation like (41a) predicts phonological order between the articulators, under usual assumptions. The two Supralaryngeal nodes are necessarily ordered; this order naturally extends to their respective dependents. Earlier, though, I took

the fact of regressive articulation as evidence that harmonic clusters are in fact phonologically unordered. I argued that we would not want to attribute regression to a stipulation in the phonology; therefore it is a fact of the phonetics of Kabardian, which is plausible if we are discussing a sort of complex segment.

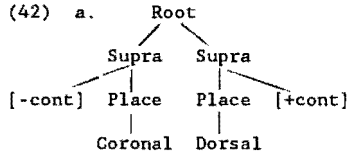
Is the solution offered here for harmonic clusters therefore wrong?[24] We could abandon it and search for other ways to account for the differences between harmonic clusters and complex segments of the sort analyzed by Sagey. I will instead advocate that we drop yet another guiding assumption: the assumption that two features (or class nodes) on one tier are ordered in a representation like (40).

This move may seem untenable, but let us look more closely. Certainly order obtains between independent segments; I will follow Selkirk (1990) (in this volume), then, and assume that phonological order can be defined only with respect to the Root node. In that case, features on one tier but linked to one Root node are not ordered; features on one tier linked to different Root nodes are.

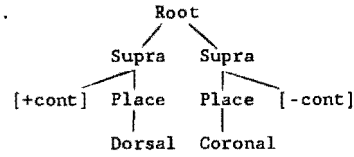
In fact, there is surprisingly limited evidence for order below the Root node. If contours (a term implying order) could exist freely for any feature, we would expect to find a very large number of contour types among languages. In fact, very few have been proposed, most notably contours for [cont] (affricates) and [nasal] (prenasalized segments). Recent work by Lombardi (to appear) has called the existence of the former into question; she shows convincingly that we need not assume phonological order to account for the facts of affricates, and moreover, there are processes involving affricates where the presumed order is violated. Though I cannot seriously pursue here other proposed contours below Root, I suggest that the facts of Kabardian presented in this paper should encourage us to explore the notion that phonological order simply does not obtain within a segment--below the Root node. A theory lacking the means to express order below the Root node is more restrictive than one predicting order. The two representations in (42), for example, are now identical in import, both representations for TX:

[24]In part due to its simple syllable structure, it is not possible to test directly for phonological order within harmonic clusters; there are no processes that reveal the answer.

(42) a.

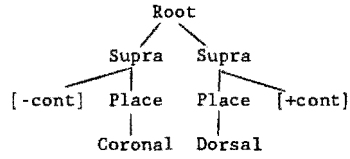


b.



Conclusion

I argued in this paper that Kabardian harmonic clusters are single segments, and that they should be represented with two Supralaryngeal nodes:



For $\underline{\bar{T}x}$

This form captures the unusual properties of these segments in a natural way:

1) Articulations may bear different underlying [cont] values.
2) We find (in limited cases) more than one instance of a single articulation type in a segment.
3) Harmonic clusters share one laryngeal articulation and major class features.

Retaining the analysis forces us to change our assumptions about phonological order within the segment. But it seems to me that these assumptions are questionable in any case, and that therefore this result is not unwelcome, though further research needs to be carried out.

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Appendix: The (Simple) Phonemes of Kabardian

	voiceless stop	voiceless fric.	voiced stop	voiced fric.	glottal. stop	glottal. fric.	nasal	trill
labial:	p	f	b	v	p'	f'	m	
dental:	t	s	d	z	t'		n	
(affr.)	c		ʒ		c'			
alveolar:								r
pal-alveolar:		ś		ź		ś'		
alv-palatal:		š		ž				
lateral:		ɬ		l		l'		
pal-velar: palatalized	k^y	x^y	g^y	γ^y	k'^y			
pal-velar: labialized	k^w	x^w	g^w		k'^w			
uvular: plain	q	χ		ɣ	q'			
uvular: labialized	q^w	χ^w		γ^w	q'^w			
pharyngeal:		ḥ						

glides: w, j, h glottal stops: ʔ, $ʔ^w$ vowel: a

Kabardian has five phonetic long vowels (a,e,o,i,u) that are the result of a combination of either a or ə plus a glide: w, j or h. E.g., [o] = a + w, [i] = ə + j, [a:] = a + h

For the argument that the velars have labialized and palatalized but no plain variants see Kuipers section 6.

The laterals are obstruent fricatives.

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